GRADE 12 DIPLOMA EXAMINATION

Chemistry 30

January 1988

Alberta
EDUCATION

GRADE 12 DIPLOMA EXAMINATION
CHEMISTRY 30

DESCRIPTION

Time: 2½ hours

Total possible marks: 70

This is a **CLOSED-BOOK** examination consisting of two parts:

PART A: 56 multiple-choice questions each with a value of 1 mark.

PART B: Three written-response questions for a total of 14 marks.

A chemistry data booklet is provided for your reference. Approved calculators may be used.

GENERAL INSTRUCTIONS

Fill in the information on the answer sheet as directed by the examiner.

For multiple-choice questions, read each carefully and decide which of the choices BEST completes the statement or answers the question. Locate that question number on the answer sheet and fill in the space that corresponds to your choice. USE AN HB PENCIL ONLY.

Example

This examination is for the subject area of

A. Chemistry
B. Biology
C. Physics
D. Mathematics

Answer Sheet

A	B	C	D
●	②	③	④

If you wish to change an answer, please erase your first mark completely.

For written-response questions, read each carefully, show all your calculations, and write your answer in the space provided in the examination booklet.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.

DO NOT FOLD EITHER THE ANSWER SHEET OR THE EXAMINATION BOOKLET

The presiding examiner will collect the answer sheet and examination booklet for transmission to Alberta Education.

JANUARY 1988

PART A

INSTRUCTIONS

There are 56 multiple-choice questions with a value of one mark each in this section of the examination. Use the separate answer sheet provided and follow the specific instructions given.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.

WHEN YOU HAVE COMPLETED PART A, PROCEED DIRECTLY TO PART B

DO NOT TURN THE PAGES TO START THE EXAMINATION UNTIL TOLD TO DO SO BY THE PRESIDING EXAMINER

1. A student collects data to determine the energy gained in changing an ice cube at $-10.0°C$ into steam at 100°C. The step involving the greatest gain in potential energy takes place as the

   A. ice is melted
   B. ice is heated to 0°C
   C. water at 0°C is heated to 100°C
   D. liquid water at 100°C is vaporized

2. Consider the change Na(s) $\longrightarrow$ Na(l) for which $\Delta H = +124$ kJ/mol. Which of the following statements is FALSE?

   A. The melting process is endothermic.
   B. The change occurs at a constant temperature.
   C. The potential energy of the sodium remains constant.
   D. The total energy involved depends upon the mass of the sodium.

Use the following properties to answer question 3.

Physical properties of acetone	
Freezing point	$-95.4°C$
Boiling point	56.2°C

3. In cooling a pure sample of liquid acetone initially at 56.2°C to $-98.0°C$, all of the changes that would occur, in order, are

   A. phase change, temperature change, phase change, temperature change
   B. temperature change, phase change, temperature change
   C. phase change, temperature change, phase change
   D. phase change, temperature change

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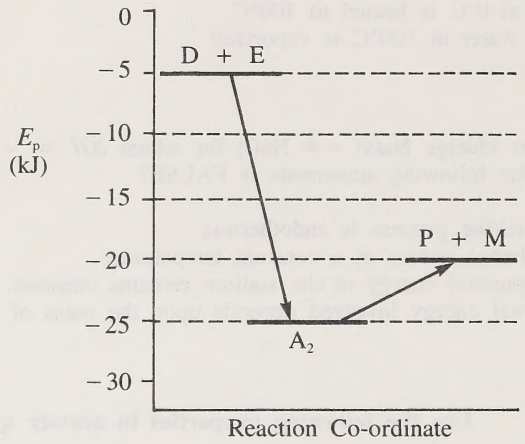
4. A positive molar heat of formation is the amount of heat

   A. absorbed when one mole of compound is formed from its elements
   B. released when one mole of compound is formed from its elements
   C. absorbed when one mole of the element is formed from the compound
   D. released when one mole of the element is formed from the compound

Use the following information to answer question 5.

An Energy Level Diagram for a Hypothetical Chemical Reaction



5. ΔH for the reaction, D + E $\longrightarrow$ P + M, is

A. −20.0 kJ
B. −15.0 kJ
C. +15.0 kJ
D. +20.0 kJ

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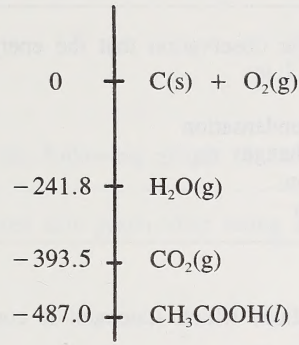
6. If the ΔH value for a given reaction is positive, then the reverse reaction

A. is exothermic
B. is endothermic
C. has a positive ΔH
D. will absorb energy

Use the following information to answer question 7.

Chemical Substances and their Relative Energies in kJ



7. The heat of reaction for the equation, $CH_3COOH(l) + 2O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(g)$, is

A. −1270.6 kJ
B. −783.6 kJ
C. −487.0 kJ
D. 783.6 kJ

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8. The process involving the largest energy change is

A. 1.00 g $C_2H_5OH(l)$ burning
B. 1.00 g $C_2H_5OH(l)$ freezing
C. 1.00 g $C_2H_5OH(g)$ condensing
D. 1.00 g $C_2H_5OH(g)$ warming through 10.0°C

9. A 1.00 g sample undergoes a change in a calorimeter, causing the temperature of 2.10 kg of water to increase from 15.2°C to 19.7°C. The equation that could represent the reaction is

A. $H_2O(g) \longrightarrow H_2O(l)$

B. $NaCl(l) \longrightarrow NaCl(s)$

C. ${}^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n$

D. $C_2H_2(g) + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(g)$

Use the following information to answer question 10.

A student formed one mole of $H_2O(l)$ at 100°C using two different methods:

I Condensing 1 mole of steam at 100°C
II Burning $H_2(g)$

10. The best interpretation for the observation that the energy released in II was about seven times that released in I is

A. II has energy due to condensation
B. I has no temperature change
C. II is a chemical reaction
D. I is a chemical reaction

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11. Given the following information, which statement is correct?

$$HCl(g) \longrightarrow HCl(aq) \qquad \Delta H = -74.9 \text{ kJ/mol}$$

A. The temperature of HCl(aq) is less than the temperature of HCl(g).
B. The temperature of HCl(aq) is greater than the temperature of HCl(g).
C. The potential energy of HCl(aq) is greater than the potential energy of HCl(g).
D. The potential energy of HCl(aq) is less than the potential energy of HCl(g).

Use the following information for hypothetical chemical reactions to answer question 12.

$$\tfrac{1}{2}X_2(s) + O_2(g) \longrightarrow XO_2(g) \qquad \Delta H = -20 \text{ kJ}$$
$$\tfrac{1}{2}X_2(l) + O_2(g) \longrightarrow XO_2(g) \qquad \Delta H = -25 \text{ kJ}$$

12. The 5 kJ difference in energy between the two heats of reaction is

A. the energy needed to melt half a mole of substance X_2
B. the heat released by the overall reaction
C. due to experimental error
D. the ΔH_f° for $XO_2(g)$

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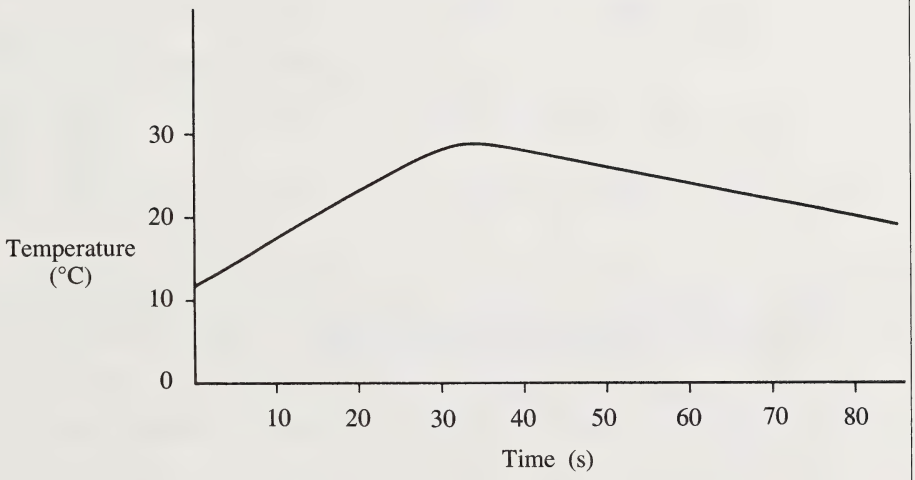
13. In an experiment, 50.0 mL of $H_2SO_4(aq)$ were added to 150.0 mL of KOH(aq). The temperature of the resulting solution increased by 4.00°C. Assume the specific heat and the density of the system to be the same as that of water. The heat produced by this reaction is

A. 0.302 kJ
B. 0.838 kJ
C. 2.51 kJ
D. 3.35 kJ

Use the following graph to answer question 14.

A student plotted this graph after doing a neutralization experiment.



14. To calculate the heat of neutralization for KOH(aq) and HCl(aq), a student mixed the solutions and recorded the temperature of the mixture each 10 s. In the calculations, the student mistakenly used the temperature attained after 50 s. What effect did this have on the heat value?

A. The heat value was too large because of the excessively large time value in the calculation.
B. The heat value was too small because energy was released that was not accounted for in this calculation.
C. The heat value was too small because the student did not wait until the reaction was completed before doing the calculation.
D. The heat value was too large due to the excessive heat lost to the surroundings during this excessive time period.

Use the following information to answer question 15.

Three chemical equations and their corresponding heats of reaction are given below:

1. $C_3H_6(g) + \frac{9}{2}O_2(g) \longrightarrow 3CO_2(g) + 3H_2O(g)$ $\quad \Delta H = -2054$ kJ
2. $C(s) + O_2(g) \longrightarrow CO_2(g)$ $\quad \Delta H = -393.5$ kJ
3. $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$ $\quad \Delta H = -241.8$ kJ

15. The heat of formation for C_3H_6 (propene) can be calculated using

A. $\Delta H_f^\circ = \dfrac{2054 \text{ kJ} + 3(-393.5 \text{ kJ}) + 3(-241.8 \text{ kJ})}{1 \text{ mol}}$

B. $\Delta H_f^\circ = \dfrac{-2054 \text{ kJ} - 3(393.5 \text{ kJ}) - 3(241.8 \text{ kJ})}{1 \text{ mol}}$

C. $\Delta H_f^\circ = \dfrac{2054 \text{ kJ} + 3(393.5 \text{ kJ}) + 3(241.8 \text{ kJ})}{1 \text{ mol}}$

D. $\Delta H_f^\circ = \dfrac{-2054 \text{ kJ} - 393.5 \text{ kJ} - 241.8 \text{ kJ}}{1 \text{ mol}}$

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16. In respiration, glucose ($C_6H_{12}O_6$) is oxidized to $CO_2(g)$ and $H_2O(l)$. When 18.02 g of glucose are oxidized, the heat of reaction is

A. +280.3 kJ
B. +28.03 kJ
C. −280.3 kJ
D. −2803.3 kJ

17. Given the reaction $Na_2O(s) + H_2O(l) + 168 \text{ J} \longrightarrow 2NaOH(s)$, the ΔH value of this reaction per mole of product is

A. +168 J
B. +84 J
C. −84 J
D. −168 J

18. A student burned a small candle and found it could warm 50 g of water from 10°C to 16°C. If a student had used three candles instead of one for the same experimental procedure, what final temperature should be predicted?

A. 18°C
B. 24°C
C. 26°C
D. 28°C

19. A property of all acidic solutions is that they

A. are completely dissociated
B. turn red litmus blue
C. conduct electricity
D. are colorless

20. A base used in some household cleaners is

A. NaOH
B. $Ca(OH)_2$
C. C_2H_5OH
D. CH_3COOH

21. Which of the following reactions can be classified as a neutralization reaction?

A. $HOOCCOOH(aq) + H_2O(l) \longrightarrow H_3O^+(aq) + HOOCCOO^-(aq)$

B. $Ba(OH)_2(aq) + Na_2SO_4(aq) \longrightarrow 2NaOH(aq) + BaSO_4(s)$

C. $2C_6H_5COOH(s) + 15O_2(g) \longrightarrow 14CO_2(g) + 6H_2O(l)$

D. $Ba(OH)_2(aq) + H_2SO_4(aq) \longrightarrow 2H_2O(l) + BaSO_4(s)$

22. A substance is an Arrhenius acid if it

A. turns neutral litmus paper blue
B. turns phenolphthalein solution pink
C. dissolves in water to form hydroxide ions
D. dissolves in water to form hydrogen ions

23. In its reaction with water, $NH_2^-(aq)$ acts as a base. In the reverse reaction, the base would be

A. $NH_3(aq)$
B. $OH^-(aq)$
C. $NH_4^+(aq)$
D. $H_2O(l)$

24. $HCO_3^-(aq)$ will act as an acid in an aqueous solution of

A. $NO_2^-(aq)$
B. $HSO_3^-(aq)$
C. $PO_4^{3-}(aq)$
D. $HSO_4^-(aq)$

25. Phosphoric acid is an example of a(n)

A. diprotic acid with an identifiable endpoint
B. monoprotic acid which can give two definite endpoints
C. organic acid which can give only one definite endpoint
D. polyprotic acid with at least two identifiable endpoints

26. Aqueous solutions of $NaHCO_3$ and $NaHSO_4$ were mixed and a gas formed. The species acting as a Brønsted-Lowry acid in this reaction is

A. $HCO_3^-(aq)$
B. $HSO_4^-(aq)$
C. $H_2CO_3(aq)$
D. $H_2SO_4(aq)$

27. A procedure which enables a student to differentiate between a strong and a weak acid of equal concentration is to

A. add sodium metal to each solution
B. test each solution with blue litmus paper
C. compare the electroconductivity of each solution
D. test each solution with indigo carmine indicator

Use the following information to answer question 28.

A student added 50 mL of 0.020 mol/L NaOH(aq) to 50 mL of each of the following solutions:

1. 0.020 mol/L HI(aq)
2. 0.020 mol/L $H_2SO_4(aq)$
3. 0.020 mol/L $C_6H_5COOH(aq)$
4. 0.020 mol/L $H_3PO_4(aq)$

28. The student should predict that the solution(s) that will still be acidic after the addition of the NaOH(aq) is/are

A. 1, 2, and 4 only
B. 1 and 3 only
C. 2 and 4 only
D. 3 only

29. Students should predict that the $[H_3O^+(aq)]$ of a fruit juice with a pH of 2.40 would be

A. 4.0×10^{-3} mol/L
B. 2.5×10^{-2} mol/L
C. 3.8×10^{-1} mol/L
D. 2.5×10^{2} mol/L

30. If the pH value of a solution is increased by 2, the hydronium ion concentration would have been

A. decreased to 0.01 times the original concentration of $H_3O^+(aq)$
B. increased to 100 times the original concentration of $H_3O^+(aq)$
C. increased to twice the original concentration of $H_3O^+(aq)$
D. decreased to half the original concentration of $H_3O^+(aq)$

31. Indicators are

A. inorganic bases that are blue in basic solutions
B. organic bases that change colors from clear to pink
C. trace quantities of a substance that indicate exact pH
D. weak acids or bases where one or both forms are colored

Use the following observations to answer question 32.

Two solutions were tested using indicators. The observations are summarized below.

Solution	Orange IV	Phenolphthalein	Bromothymol Blue
X	yellow	pink	blue
Y	yellow	colorless	yellow

32. A correct interpretation of these observations is that

A. both solutions are basic
B. both solutions are acidic
C. solution X is basic and solution Y is acidic
D. solution X is acidic and solution Y is basic

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33. Which of the following is the correct net ionic equation for the neutralization of hydrocyanic acid using aqueous potassium hydroxide?

A. $H^+(aq) + CN^-(aq) + K^+(aq) + OH^-(aq) \rightleftharpoons H_2O(l) + K^+(aq) + CN^-(aq)$

B. $HCN(aq) + OH^-(aq) \rightleftharpoons H_2O(l) + CN^-(aq)$

C. $HCN(aq) + KOH(aq) \rightleftharpoons H_2O(l) + KCN(aq)$

D. $H^+(aq) + OH^-(aq) \rightleftharpoons H_2O(l)$

Use the following information to answer question 34.

A student is given information about four hypothetical acids:

1. 0.010 mol/L HA(aq) has a pH of about 3
2. 10 mol/L HB(aq) has a pH of about 6
3. 0.10 mol/L HC(aq) has a pH of about 1
4. 10 mol/L HD(aq) has a large K_a and a large % reaction with water

34. The student should predict that an example of a dilute strong acid is

A. HA(aq)
B. HB(aq)
C. HC(aq)
D. HD(aq)

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35. The reaction that will favor reactants at equilibrium is

A. $HBb(aq) + NH_3(aq) \rightleftharpoons Bb^-(aq) + NH_4^+(aq)$

B. $HOCl(aq) + CN^-(aq) \rightleftharpoons HCN(aq) + OCl^-(aq)$

C. $HCO_3^-(aq) + HCN(aq) \rightleftharpoons H_2CO_3(aq) + CN^-(aq)$

D. $HCOOH(aq) + CH_3COO^-(aq) \rightleftharpoons HCOO^-(aq) + CH_3COOH(aq)$

Use the following data to answer question 36.

During a titration, results were recorded for two trials of the complete neutralization of 0.100 mol/L $Na_2CO_3(aq)$ with HCl(aq).

	Trial 1	Trial 2
Volume of $Na_2CO_3(aq)$	20.00 mL	20.00 mL
Volume of HCl(aq)	21.51 mL	21.49 mL

36. What volume of this HCl(aq) solution would be necessary to completely neutralize 20.00 mL of 0.100 mol/L NaOH(aq)?

A. 37.2 mL
B. 18.6 mL
C. 10.8 mL
D. 9.30 mL

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37. 20.0 mL of 0.0400 mol/L $H_2SO_4(aq)$ are titrated by the addition of 0.0600 mol/L NaOH(aq). What volume of NaOH(aq) is needed to reach the final endpoint of the titration?

A. 6.67 mL
B. 13.3 mL
C. 26.7 mL
D. 30.0 mL

38. When $Cl_2(g)$ is reduced to produce $2Cl^-(aq)$ ions, the $Cl_2(g)$

A. gains 1 e^-
B. gains 2 e^-
C. loses 1 e^-
D. loses 2 e^-

39. A student placed a strip of aluminum in a test tube that contained a solution of copper (II) sulfate. After 5 minutes, the student observed that the aluminum strip had a coating on its surface. Choose the correct interpretation, based on this observation.

A. The sulfate ions were reduced.
B. The aluminum strip was oxidized.
C. The copper (II) ions were oxidized.
D. The aluminum acted as an oxidizing agent.

40. Reducing agents are capable of

A. releasing electrons
B. undergoing reduction
C. forming metallic atoms
D. reacting with non-metallic ions

41. A piece of chromium metal, Cr(s), is placed into a container which is then filled with chlorine gas, $Cl_2(g)$. The balanced redox equation is

A. $Cr(s) + 3Cl^-(aq) \longrightarrow CrCl_3(s)$
B. $2Cr(s) + 3Cl_2(g) \longrightarrow 2CrCl_3(s)$
C. $2Cr(s) + 2Cl_2(g) \longrightarrow 2CrCl_2(s)$
D. $Cr(s) + Cl_2(g) \longrightarrow Cr^{3+}(aq) + 2Cl^-(aq)$

42. In the following equation,
$2MnO_4^-(aq) + 5AsO_3^{3-}(aq) + 6H^+(aq) \longrightarrow 2Mn^{2+}(aq) + 5AsO_4^{3-}(aq) + 3H_2O(l)$,
the oxidation number of the element oxidized is

A. increased by 2
B. decreased by 2
C. increased by 5
D. decreased by 5

Use the following information to answer question 43.

A student considers this unbalanced partial equation which represents a redox reaction in acidic solution, and four derived half-reactions:

$N_2O(g) + H_2SeO_3(aq) \longrightarrow N_2(g) + SeO_4^{2-}(aq)$ (redox equation)

I. $H_2O(l) + H_2SeO_3(aq) \longrightarrow SeO_4^{2-}(aq) + 4H^+(aq) + 2e^-$

II. $2H^+(aq) + N_2O(g) + 2e^- \longrightarrow N_2(g) + H_2O(l)$

III. $H_2(g) + N_2O(g) + 2e^- \longrightarrow N_2(g) + H_2O(l)$

IV. $H_2SeO_3(aq) + 4H^+(aq) + 2O_2(g) + 6e^- \longrightarrow SeO_4^{2-}(aq) + 3H_2O(l)$

43. The half-reactions that would balance the redox reaction are

A. I and II
B. I and III
C. II and III
D. II and IV

Use the following data to answer question 44.

In a titration experiment, $K_2Cr_2O_7(aq)$ was used to determine the concentration of $Fe^{2+}(aq)$ in an acidified solution of $FeCl_2(aq)$. The following data were recorded:

Concentration of $K_2Cr_2O_7(aq)$	0.0500 mol/L
Volume of $FeCl_2(aq)$	10.00 mL
Final Buret Reading	30.2 mL
Initial Buret Reading	0.2 mL

44. The concentration of $Fe^{2+}(aq)$ ions in the $FeCl_2(aq)$ solution is

A. 2.78×10^{-3} mol/L
B. 2.50×10^{-2} mol/L
C. 1.00×10^{-1} mol/L
D. 9.00×10^{-1} mol/L

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45. The volume of 0.0250 mol/L $Ag^+(aq)$ necessary to react exactly with 2.18 g of Zn(s) is

A. 1.33 L
B. 1.68 L
C. 2.67 L
D. 3.35 L

46. The species that will oxidize Pb(s) to $Pb^{2+}(aq)$ but will not oxidize $I^-(aq)$ to $I_2(s)$ are

A. $F_2(g)$ and $Fe^{3+}(aq)$
B. $Cu^{2+}(aq)$ and $Br_2(l)$
C. $Cd^{2+}(aq)$ and $Ag^+(aq)$
D. $Cu^{2+}(aq)$ and $Sn^{4+}(aq)$

47. An unknown metal X(s) was used in an electrochemical cell with Cu(s) and the voltage was found to be 1.80 V. The cell reaction was

$$X(s) + Cu^{2+}(aq) \longrightarrow X^{2+}(aq) + Cu(s) \qquad E^\circ = 1.80 \text{ V}$$

What is the standard reduction potential for $X^{2+}(aq)$?

A. +2.14 V
B. +1.46 V
C. −1.46 V
D. −2.14 V

48. The correctly written oxidation half-reaction with the appropriate E° value is

A. $Fe(s) \longrightarrow Fe^{3+}(aq) + 3e^-$ $\quad E^\circ = -0.04$ V
B. $Cr^{2+}(aq) \longrightarrow Cr^{3+}(aq) + e^-$ $\quad E^\circ = +0.41$ V
C. $Ag(s) + I^-(aq) \longrightarrow AgI(s) + e^-$ $\quad E^\circ = +0.54$ V
D. $Fe^{3+}(aq) \longrightarrow Fe^{2+}(aq) + e^-$ $\quad E^\circ = -0.77$ V

49. Which of the reducing agents in the following half-reactions will spontaneously reduce $Cu^{2+}(aq)$ to Cu(s)?

A. $Mn^{2+}(aq) + 4H_2O(l) \longrightarrow MnO_4^-(aq) + 8H^+(aq) + 5e^-$
B. $Sn^{2+}(aq) \longrightarrow Sn^{4+}(aq) + 2e^-$
C. $2Cl^-(aq) \longrightarrow Cl_2(g) + 2e^-$
D. $Ag(s) \longrightarrow Ag^+(aq) + e^-$

50. A piece of lead metal is placed in a beaker that contains a solution of iron (III) chloride. The E°_{net} for the most probable reaction is

A. -0.64 V
B. $+0.31$ V
C. $+0.64$ V
D. $+0.90$ V

51. What is the net potential of a cell for which the half-cells include Mg(s) in $Mg^{2+}(aq)$ and $I_2(s)$ in $I^-(aq)$?

A. -2.92 V
B. -1.84 V
C. $+1.84$ V
D. $+2.92$ V

52. A chemical explanation for using copper pipes rather than iron pipes in plumbing is that

A. iron has a greater tendency to be oxidized than copper
B. iron will react with dissolved minerals such as calcium
C. copper has a greater ability to transmit heat energy than iron
D. commercial drain cleaners like sodium hydroxide will react with iron

53. During the operation of an electrochemical cell, electrical neutrality is maintained within the cell because

A. the ions are free to migrate
B. reduction occurs at the cathode
C. oxidation occurs at the anode
D. the flow of electrons produces a current

54. Electrolytic cells differ from electrochemical cells in that

A. anions migrate toward the cathode in an electrolytic cell and to the anode in an electrochemical cell

B. electrolytic cells involve exothermic chemical reactions, while electrochemical cells involve endothermic reactions

C. electrolytic cells convert electrical energy to chemical energy, whereas chemical energy is converted to electrical energy in an electrochemical cell

D. electrolytic cells have a positive E°_{net} value indicating a spontaneous chemical reaction, while electrochemical cells have a negative E°_{net} value indicating that a minimum amount of energy is needed for the chemical reaction to occur

Use the following information to answer question 55.

A student determined that the following combinations of unidentified metals and their aqueous ions would react spontaneously.

$$A + B^{2+} \longrightarrow A^{2+} + B$$
$$B + C^{2+} \longrightarrow B^{2+} + C$$
$$C + D^{2+} \longrightarrow C^{2+} + D$$
$$B + E^{2+} \longrightarrow B^{2+} + E$$
$$D + E^{2+} \longrightarrow D^{2+} + E$$

55. The student should predict that the strongest oxidizing agent is

A. E^{2+}
B. A^{2+}
C. B^{2+}
D. C^{2+}

---

56. In the electroplating process, a reason why metals are plated at the cathode is that

A. electrons flow to the anode
B. oxidation occurs at the cathode
C. the cathode dissolves in the reaction
D. metal ions are commonly reduced to the solid

YOU HAVE NOW COMPLETED THE MULTIPLE-CHOICE SECTION OF THE EXAMINATION. PLEASE PROCEED TO THE NEXT PAGE AND ANSWER THE WRITTEN-RESPONSE QUESTIONS IN PART B.

PART B

INSTRUCTIONS

Please write your answers in the examination booklet as neatly as possible.

Marks will be awarded for pertinent explanations, calculations, formulas, and answers. Answers must be given to the appropriate number of significant digits.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work.

TOTAL MARKS: 14

START PART B IMMEDIATELY

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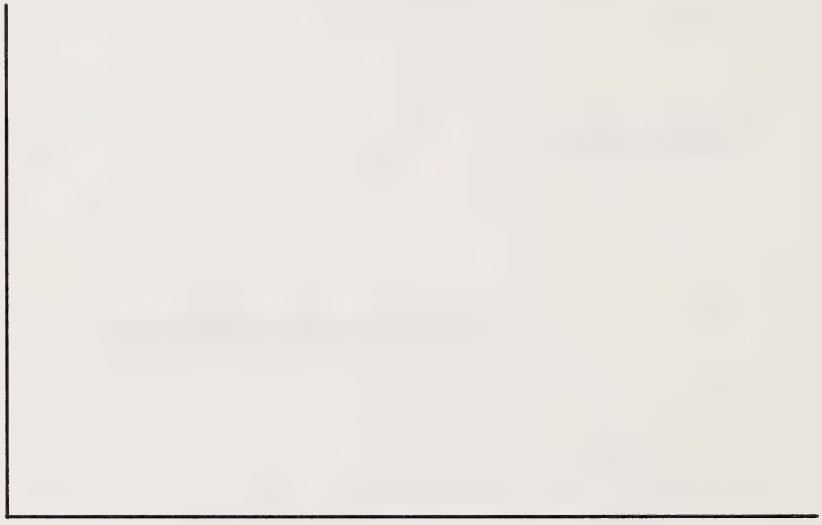
(5 marks)

1. Under appropriate conditions, methanoic acid, $HCOOH(l)$, decomposes to form carbon monoxide, $CO(g)$, and water vapor, $H_2O(g)$.

   a. How much energy is involved when 1 mol of methanoic acid decomposes?

   b. Clearly draw and label the potential energy diagram that represents the decomposition of one mole of methanoic acid.



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2. A student is given four unknown 0.10 mol/L solutions: a strong acid, a weak acid, a weak base, and a neutral electrolyte. A high school laboratory is available, with the exception of equipment to identify exact pH values.

(5 marks)

Describe an experimental procedure that the student may use to identify each of the solutions. For each step in the procedure, identify the relevant observations and how to use them.

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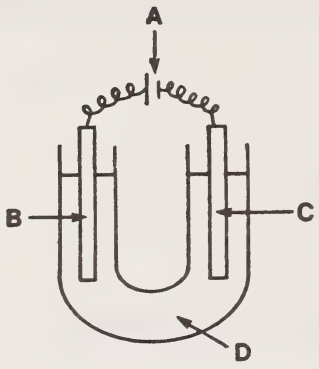
Use the following information to answer question 3.

A student made only the following observations after an electric current had passed through the NaI(aq) solution for some time.



anode – smells like iodine

cathode – solution has a pH of 12

A – power supply
B and C – inert electrodes
D – aqueous NaI

(4 marks)

3. a. Write the equation for the half-reaction occurring at the anode.

b. Account for the fact that no Na(s) forms at the cathode.

c. The student missed making an obvious observation at the cathode. What else should have been observed?

YOU HAVE NOW COMPLETED THE EXAMINATION. IF YOU HAVE TIME, YOU MAY WISH TO GO BACK AND CHECK YOUR ANSWERS.

TEAR-OUT SHEET

(NO MARKS WILL BE GIVEN FOR WORK DONE ON THIS PAGE)

FOLD AND TEAR ALONG PERFORATION

TEAR-OUT SHEET

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FOLD AND TEAR ALONG PERFORATION

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M1 M2 M3 M4

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